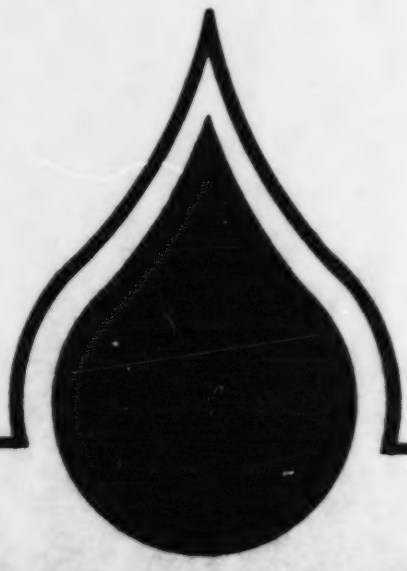
EIGHTH

ANNUAL REPORT

MARCH 31
1983

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

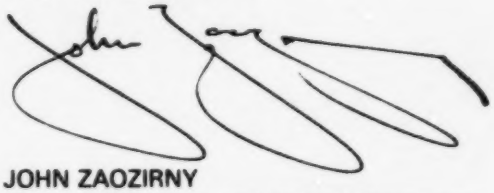


TO HIS HONOUR
FRANK LYNCH-STAUNTON
LIEUTENANT GOVERNOR OF THE PROVINCE OF ALBERTA

Sir,

I have the honour to submit the Annual Report of the ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY for the fiscal year ended March 31, 1983.

Respectfully submitted,



JOHN ZAOZIRNY
Minister of Energy and Natural Resources

Eighth

ANNUAL REPORT

March 31,
1983

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

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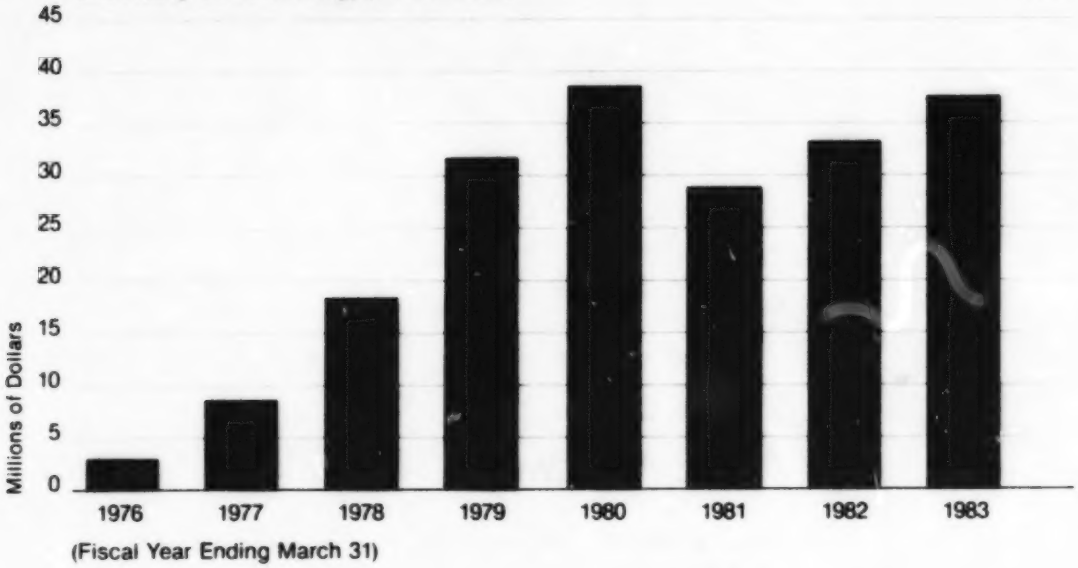
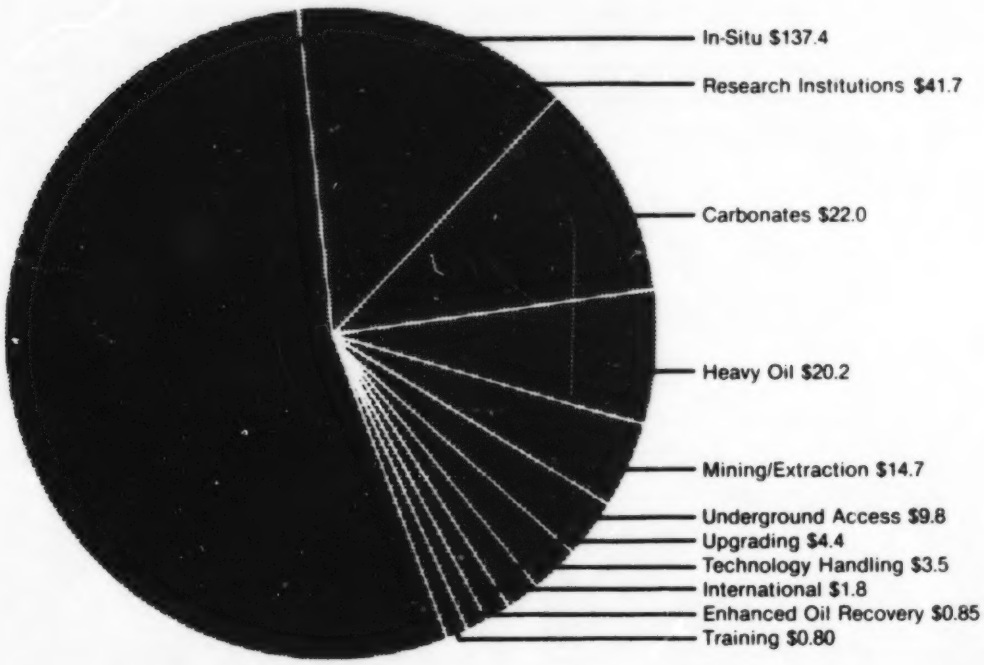
FOREWORD

On January 14, 1974, the Premier of Alberta announced the availability of $100 million to develop new technology for the recovery and processing of petroleum from the Alberta Oil Sands. The terms and conditions for the disbursement of these funds are described in The Oil Sands Technology and Research Authority Act, passed by the Legislature in June 1974 and since amended to include the recovery of heavy oils and the enhanced recovery from conventional petroleum reservoirs. An additional $318 million has been dedicated by the Alberta Government to permit the funding of longer term programs extending beyond 1985.

Annual Investment by AOSTRA in Oil Sands and Heavy Oil Technology (1976 to 1983)

Figure 1





Commitments from AOSTRA Research Fund To March 31, 1983 ($Millions)

Figure 2

EIGHTH ANNUAL REPORT
of the
ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY

To the Honourable John Zaozirny
Minister of Energy and Natural Resources

Sir,

I have the honour to present the Eighth Annual Report of the Alberta Oil Sands Technology and Research Authority (AOSTRA) for the year ended March 31, 1983.

The AOSTRA/Industry field pilot tests in the various oil sands and heavy oil reservoirs continued during the past year. Highlights for each project are given below.

Peace River Deposit

- The AOSTRA/Shell Canada Resources Limited project is now well into its first pressure blowdown phase and produced its one-millionth barrel of oil near the end of the fiscal period. The steam/oil ratio, an important production criterion which governs economics, is on target and approximately 12% of the original oil in place in the pilot area has been recovered. It is expected that approximately 16% of the oil in place will have been produced at the end of the first blowdown phase, expected late in 1983. Forecasts indicate that 55% of the oil in place will have been recovered at the end of the test program.

Athabasca Deposit

- Since the loss of our industrial partner in the project to drill horizontal wells from shafts and tunnels, AOSTRA has proceeded to complete the design and site selection for the test program. The pilot will be located on Crown land approximately five kilometers west of the boundary of the Syncrude Canada Ltd. lease. AOSTRA will be seeking industrial participation in the program during 1983.
- The Xana Engineering Ltd. laboratory program for removal of clay from the tailings produced in the Hot Water Extraction Process will be completed in mid 1983. The results of this program together with preliminary cost estimates of a conceptual commercial design will form a basis for an AOSTRA/Industry decision on demonstration testing.
- Pilot testing of the UMATAC Industrial Processes Ltd. Dry Retorting Process for extracting oil from mined oil sands has been largely completed. A 180 tonne per hour demonstration plant is currently being designed along with an economic comparison of this process with the conventional Hot Water Extraction Process. A decision on construction of the demonstration plant will be made during the next fiscal period.
- AOSTRA and nine other organizations have finalized the conceptual design of an Oil Sands Demonstration Centre for the testing of new extraction technology. A specific proposal for construction of this facility in the Ft. McMurray area has been circulated to the various government and industry participants in the program.

Carbonate Deposit

- Construction of the AOSTRA/Union Oil Company of Canada Ltd. five spot pilot was completed during 1982 and is now in operation. Injection and production operations are forecast to continue for 2 1/2 years. The existing single well pilot is continuing to show good results.

Cold Lake Deposit

- The AOSTRA/BP Exploration Canada Limited pilot at Marguerite Lake continued operations during 1982 in the initial steam stimulation mode of operation. The results have been sufficiently encouraging to warrant the operator to develop a 7000 barrel per day commercial project. The pilot will convert to the second phase, involving wet combustion, during 1983. AOSTRA and BP have carried out additional combustion tests using oxygen-enriched air. A single well pilot in another geological zone was also carried out to provide further information on the Cold Lake deposit.

Enhanced Recovery of Conventional and Heavy Oils

- The AOSTRA/Petro-Canada Exploration Inc. combustion pilot in the Viking-Kinsella field has been expanded to form a two five spot patterns. Injection and production operations are forecast to continue for two years.
- Air injection has been underway since February 1982 on the AOSTRA/ Alberta Energy Company Ltd. combustion pilot in the Suffield Block and to-date the reservoir has responded favourably. Injection and production operations are expected to continue for another three years.
- A letter of intent was finalized during 1982 with Vikor Resources Ltd. for testing the CO_2 flooding process in a watered-out reservoir in the Joffre conventional oil pool near Red Deer. The formal legal agreements are currently being prepared, and the pilot is expected to commence operation during 1983.

Heavy Oil Upgrading

- The engineering firm engaged by AOSTRA and twelve other organizations has completed its assessment of nine new upgrading processes and is in the process of finalizing its report. A specific proposal for construction of a demonstration plant will be made to the project participants during 1983.

Other General AOSTRA Activities:

- An international technology marketing group has been established to follow up the most promising prospects identified in previous AOSTRA international visits. The most active exchanges are currently with Brazil, Madagascar, The People's Republic of China, and the United States. Two groups representing the Chinese petroleum industry spent a month in Alberta studying Alberta drilling and workover procedures under winter conditions.
- AOSTRA and nine industrial participants have initiated the first phase of a co-operative project to evaluate and test technologies for utilization of the cokes and residua produced in the upgrading of Alberta bitumens and heavy oils. This is one of a series of AOSTRA initiatives in establishing industry groups to address major technological hurdles. This form of collaboration has been well received by industry.
- A formal method has been established for access by industry to the Alberta Research Council technology in heavy oil and oil sands. Several organizations are currently participating in the access program.
- The Petroleum Recovery Institute in Calgary provides laboratory support for Alberta's enhanced oil recovery activities. Due to the need to maintain close contact between this work and the field projects supported by AOSTRA, the Department of Energy and Natural Resources has requested that AOSTRA assume the Alberta government support to this organization previously provided by the Department.
- AOSTRA is concerned about the lack of job opportunities for recent Ph.D. graduates in disciplines of interest to the oil sands industry, and has therefore instituted an Industrial Post-Doctoral Fellowship Program to provide such graduates with working assignments in industry. AOSTRA has also made plans to increase significantly its support of summer students in 1983.
- AOSTRA was not designed to be a business enterprise with the objective of fully recovering its cost. Nevertheless, AOSTRA does attempt to provide an appropriate level of cost recovery on projects which have near-term use to industry. To date AOSTRA has received $9.4 million in revenue from sale of technology rights and a further $9.8 million from production revenue. The status of AOSTRA's revenue program is summarized following this letter, on page 12.

Perspective

As AOSTRA moves into its ninth year of operation, a number of critical developments and decisions are pending. In the in situ area, BP is planning to expand the AOSTRA/BP pilot at Cold Lake to a commercial venture. Additional tests at the AOSTRA/Shell pilot at Peace River will be undertaken to enhance the commercial attractiveness of this project. The Athabasca deposit continues to be the most challenging and no satisfactory in situ oil recovery method has yet been identified. However, AOSTRA will be aggressively pursuing a number of new Athabasca area programs.

It is clear that the present Hot Water Extraction Process does not operate effectively on the higher clay content feedstocks prevalent on many of the surface-mineable leases. The time is therefore appropriate to test the front-running alternatives to the Hot Water Extraction Process on a scale large enough to win the confidence of prospective users, and for this reason, AOSTRA believes the Oil Sands Demonstration Centre should proceed. It has been argued previously that there was insufficient time to develop new extraction technology to meet the development schedule of the next mining project. The slowdown in the economy has opened up a time window and this opportunity should not be lost.

The role that AOSTRA is now playing in Alberta is somewhat different than that originally foreseen at the time of AOSTRA's inception in 1975.

The initial plan was that AOSTRA would select a relatively small number of projects, representing the most promising technologies, and provide support to bring these to commercial fruition. At present, industry is expecting AOSTRA to participate in a wide spectrum of programs ranging from the development of new equipment, such as oil field pumps, to the final, pre-commercial demonstration of integrated technology for the recovery and processing of bitumen from specific leases. It is clear that AOSTRA is seen by the private sector as a major instrument for diversifying the economic and industrial base for the Province.

Respectfully submitted,

C W Bowman

C.W. Bowman, P.Eng.
Chairman

AOSTRA'S COST RECOVERY POLICY

The policy of AOSTRA is to provide an incentive to the private sector to develop economically viable and environmentally acceptable petroleum technology. Although the AOSTRA program is not designed for complete cost recovery, cost sharing and cost recovery agreements have been established where appropriate, as described below:

IN SITU FIELD PROJECTS

- AOSTRA normally pays 50% of net project costs, with the potential for cost recovery from technology marketing.
- In a few cases, AOSTRA has paid a higher percentage (up to 100% in one case), with the potential for repayment of the excess above 50% from future commercial oil production revenue, and repayment of the balance from technology marketing

AOSTRA DATA BASE MANAGEMENT SYSTEM

- During 1982/83, 83% of the cost of the data base system was recovered from specific field projects. (AOSTRA contributes 50% of these costs for projects in which it is participating)

TESTING OF DEVELOPED TECHNOLOGY

- AOSTRA requires a pay-back of three times its financial contribution out of future technololgy sales and/or commercial activity

OIL SANDS INFORMATION CENTRE

- During 1982/83 AOSTRA recovered 10% of the cost of this publicly available information system from subscription fees and information handling services.

OIL SANDS SAMPLE BANK

- During 1982/83 AOSTRA recovered 27% of the costs of storing and shipping controlled samples of oil sands and various products to industrial and private research laboratories

AOSTRA UNIVERSITY PROJECTS

- During 1982/83 AOSTRA recovered 34% of the cost of its university program from industry access participants.

MEMBERS OF THE AUTHORITY

CHAIRMAN

Dr. C.W. Bowman

VICE-CHAIRMAN

Mr. M.A. Carrigy

MEMBERS

Dr. H.E. Gunning

Mr. J.A. Harvie

Mr. F.A. Kidd

Mr. J.E. Miller

Mr. M.G. Pahl*

Dr. E.J. Wiggins

HEAD OFFICE

5th Floor, Highfield Place
10010 - 106 Street
Edmonton, Alberta
T5J 3L8

CALGARY OFFICE

10th Floor, Energy Resources Building
640 - 5th Avenue S.W.Calgary, Alberta
T2P 0M6

* Resigned during 1982

STAFF

EXECUTIVE

Dr. C.W. Bowman, P. Eng., Chief Executive Officer
Mr. M.A. Carrigy, P. Geol., Chief Administrative Officer
Mrs. B.J. Stonier, Executive Assistant to Chairman

TECHNICAL

Edmonton

Mr. R.T. Bailey, P.Eng., Senior Project Engineer - Upgrading
Mrs. K.J. Cochrane, Project Engineer
Dr. T.J. Cyr, Manager, Technical Programs
Mr. R.R. Germain, Project Engineer - Upgrading
Dr. C. Hsi, P.Eng., Senior Project Engineer
Mr. G.H. Sayer, Project Engineer
Mr. A.C. Thakrar, Project Specialist
Mr. L.R. Turner, P. Eng., Director, Mining, Extraction & Upgrading
Mr. F.J. Werth, Manager, Mining & Extraction Processes

Calgary

Mr. M.S. Carleton, CDP, Data Base Administrator
Mr. R.T. Curry, Systems Analyst
Mr. H.S. Chhina, Reservoir Engineer
Mr. N.R. Edmunds, P. Eng., Senior Reservoir Engineer
Mr. T.E. Evans, Project Engineer
Mr. M.E. McCormack, P. Eng., Senior Facilities Engineer
Mr. R.S. Phillips, P. Eng., Director, In Situ Operations
Mr. F.S.L. Tam, Reservoir Engineer
Mr. D. Wilson, Systems Analyst

ADMINISTRATIVE

Edmonton

Mrs. L.G. Benzer, Information & Records Officer
Miss D.L. Borhen, Receptionist
Mr. W.G. Kowaluk, C.A., Manager, Finance & Administration
Mr. L.J. Miskiw, Administrative Accountant
Mrs. S.A. Reimond, Secretary
Miss D.M. Shulak, Records Co-ordinator
Miss E.K. Spady, LL.B, General Counsel
Mrs. B.J. Thom, Secretary
Mr. G.A. Villett, Registrar

Calgary

Mrs. M.H. Wagner, Secretary
Ms. V.M. Foster, Receptionist

CONSULTANTS

PROJECT TECHNICAL REPRESENTATIVES

Mr. H.T. Gennings (AOSTRA/BP Project)

Mr. W.K. Good, P. Eng. (AOSTRA/General American Project)

Mr. P.J. Jespersen (AOSTRA/Amoco Project)

Mr. F.W. Kelly, P. Eng. (AOSTRA/Shell Project)

Mr. G.A. McGuffin, P. Eng. (AOSTRA/Petro-Canada Project)

Mr. K.R. Ronaghan, (AOSTRA/AEC Project)

Mr. B.H. Sherwood, P. Eng. (AOSTRA/UMATAC Project)

Mr. G. Van der Voet (AOSTRA/Union Project)

TECHNICAL ADVISORS TO STAFF

Dr. R.M. Butler, P. Eng., Director, Technical Programs

Mr. J. Chrones, P. Eng., Heavy Oil Upgrading Study

Mr. G.M. Cordell, P. Eng., Senior Reservoir Engineer

Mr. M.R. Farries, P. Eng., Oil Sands Demonstration Centre

Mrs. S.E. Green, Technology Librarian

Mr. T.F. Harkness, P. Eng., Produced Water Treatment Study

Dr. L.G. Hepler, Manager, University Research

Mr. P.H. Holst, P. Eng., Mathematical Modelling

Mr. R.D. Humphreys, P. Eng., UMATAC Management Committee

Dr. R.W. Luhning, P. Eng., Manager, Thermal Projects

Mr. J.H. Nicholls, P. Eng., Director, Technical Programs

Dr. D.A. Redford, P. Eng., Manager, Technical Development

Mr. J.D. Scott, P. Eng., Manager, Enhanced Recovery

Mr. H.G. Stephenson, P. Eng., Mining

Mr. W. Vandenhengel, P. Eng., UMATAC Technical Committee

Mr. A.G. Winestock, P. Eng., Manager, International Programs

LEGAL

Miss H.S. Tymoczko, LL.B.

Mr. E.P. Johnson, (Patents & Technology Agreements)

Field and Field (Project Agreements)

PROJECT AUDITORS

Touche Ross & Co.

MEMBERS OF APPRAISAL PANELS

UNIVERSITY OIL SANDS RESEARCH EVALUATION PANEL

Dr. D.W. Bennion, P. Eng., University of Calgary

Dr. R.M. Butler, P. Eng., Alberta Oil Sands Technology and Research Authority

Mr. T. Buxton, Amoco Canada Petroleum Company Ltd.

Dr. T.J. Cyr, Alberta Oil Sands Technology and Research Authority

Dr. J.K. Donnelly, P. Eng., BP Exploration Canada Limited

Dr. L.G. Hepler, (Chairman), University of Lethbridge

Dr. H.R. Krouse, University of Calgary

Dr. D.B. Livesey, Texaco Canada Resources Ltd.

Dr. A. Logan, Gulf Canada Resources Inc.

Dr. D.S. Montgomery, University of Alberta

SCHOLARSHIP AND FELLOWSHIP SELECTION COMMITTEE

Dr. G. Berg, University of Calgary

Dr. H.E. Gunning, Alberta Oil Sands Technology and Research Authority

Dr. J.B. Hyne, University of Calgary

Dr. K.G. McCurdy, University of Lethbridge

Dr. F.D. Otto, P. Eng., University of Alberta

Dr. E.J. Wiggins, P. Eng., Alberta Oil Sands Technology and Research Authority

Dr. S.B. Woods (Chairman), University of Alberta

PATENT COMMITTEE

Dr. R.M. Butler, P. Eng., Alberta Oil Sands Technology and Research Authority

Mr. M.A. Carrigy, P. Geol., Alberta Oil Sands Technology and Research Authority

Dr. T.J. Cyr, (Chairman), Alberta Oil Sands Technology and Research Authority

Dr. L.G. Hepler, University of Lethbridge

Dr. R.W. Luhning, P. Eng., Alberta Oil Sands Technology and Research Authority

Mr. J.H. Nicholls, P. Eng., Alberta Oil Sands Technology and Research Authority

Miss E.K. Spady, LL.B., Alberta Oil Sands Technology and Research Authority

Mr. L.R. Turner, P. Eng., Alberta Oil Sands Technology and Research Authority

REPORT OF ACTIVITIES

For further information contact one of the following persons:

General

Mrs. L.G. Benzer, 500 Highfield Place, 10010 - 106 Street,Edmonton, Alberta T5J 3L8, Telephone (403) 427-7623 Telex 037-3519

Applications for Funding

Mr. G.A. Villett, 500 Highfield Place, 10010 - 106 Street, Edmonton, Alberta T5J 3L8, Telephone (403) 427-7623 Telex037-3519

Technology Sales

Mr. J.H. Nicholls, 500 Highfield Place, 10010 - 106 Street, Edmonton, Alberta T5J 3L8, Telephone (403) 427-7623 Telex 037-3519

Published Information

Mrs. H. Radvanyi, 6th Floor, Highfield Place, 10010 - 106 Street, Edmonton, Alberta T5J 3L8, Telephone (403) 427-8382

REPORT OF ACTIVITIES

1. IN SITU OIL SANDS RECOVERY PROGRAM

1.1 AOSTRA - AMOCO Gregoire Lake Pilot Project

The original AOSTRA/Amoco Canada Petroleum Company Ltd. wet combustion pilot (Block 1) was located in the south Athabasca oil sands deposit. It was terminated in mid-1981 and the injection and production wells have now all been abandoned.

A review of the results from this pilot has been concluded and a joint AOSTRA/Amoco/Petro Canada technical study group has developed a program for a new project in the area, using steam and steam plus additive processes.

An agreement between AOSTRA, Amoco and Petro Canada is currently being negotiated and it is expected that field activity on the new pilot will commence late in 1983.

1.2 AOSTRA - BP Marguerite Lake Pilot Project

The AOSTRA/BP Exploration Canada Limited project, located in the Clearwater sandstone of the Cold Lake oil sands deposit, is designed to test steam stimulation followed by wet combustion. Hudson's Bay Oil and Gas Company Limited and PanCanadian Petroleum Limited are also participants in the project.

The project is now in its fourth year of operation and the initial steam stimulation phase is essentially complete. Concurrent special test wells on air injection confirmed the original plan to follow the steam stimulation phase with air injection to improve ultimate recovery. Feasibility studies have led to a decision to use oxygen instead of air for the combustion phase, and the first of the oxygen injection wells is now in operation in the main pilot area. Two other wells will be converted to oxygen injection during 1983, and this will complete the pilot conversion to the combustion phase. This phase is planned to continue for two years.

1.3 AOSTRA - BP B-Unit Pilot Project

AOSTRA and BP Exploration Canada Limited are conducting a single well cyclic steam stimulation project (B-Unit Pilot) with two observation wells in the Lower Grand Rapids formation of the Cold Lake oil sands deposits. The object of the B-unit pilot is to test novel fracturing/injection methods to improve bitumen recovery which were developed at the AOSTRA-BP Marguerite Lake pilot 10 km to the north. The producing zone is 16 m thick at a depth of 430 m.

Over the past year, the pilot wells were drilled, surface facilities constructed, steam stimulation conducted and the injector/producer was placed on production. Initial results are encouraging and a second steam stimulation cycle will be started in mid 1983.

1.4 AOSTRA - SHELL Peace River Pilot Project

The AOSTRA-Shell Canada Resources Ltd./Shell Explorer Ltd. Peace River Project, located 30 km northeast of Peace River, is designed as a prototype installation which hopefully will lead to a commercial-scale operation. Amoco Canada Petroleum Company Ltd. is also a participant in this project.

At the pilot site the oil sands are at a depth of 550 m and are 27 m thick. The oil sands deposit under the Shell lease has an average of 3 m bottom interval of high water saturation, which has provided an initial path for steam movement at the base of the reservoir.

The test is evaluating cyclic pressurization of the reservoir using steam. This process was extensively investigated by physical and mathematical simulation tests prior to the field tests.

Construction was completed and the operating phase commenced in the fall of 1979. Construction cost was approximately $70 million and annual operating costs are in the order of $15 million.

Steam stimulation and the first pressurization cycle of the producing wells have been completed and the first blow down phase is proceeding. It is anticipated that this first cycle will be complete late in 1983. At that time, based on results to date, approximately 16% of the original oil in place will have been produced. Indications are that additional cycles will result in ultimate recovery of 55% of the original oil in place.

Plans for the second cycle are currently being prepared.

A decision has been made to test production through cyclic steam stimulation and three new wells in a special area adjacent to the main pilot area will be drilled for this purpose. The results of the test will provide information on the use of cyclic steam stimulation as a precursor to the cyclic pressurization recovery process under development in the main pattern area.

1.5 AOSTRA - UNION Buffalo Creek and McLean Pilot Projects

Activity with Union Oil Company of Canada Limited and Canadian Superior Oil Ltd. to develop technology to produce the very large reserves of bitumen in the Devonian carbonate formations continued successfully throughout the year.

This project is located approximately 100 km west of Ft. McMurray, and tests since 1977 have been conducted in the Grosmont 2 formation to examine steam stimulation, steam drive and wet combustion processes.

Operations during the 1982-83 period continued through cycles 7 and 8 on a single well steam stimulation test. The first steam stimulation cycle on a the new 5-spot pattern (McLean pilot) was completed and production is now underway.

Preliminary tests of the Grosmont 3 formation in one of the earlier wells, special tests on the single well pilot and continued operation of the McLean pilot are planned for 1983-84.

Overall results continue to be encouraging and early expansion is under consideration by the operator, Union Oil.

1.6 AOSTRA - GENERAL AMERICAN Joli Fou Wabiskaw Pilot Project

AOSTRA has obtained access and licensing rights to technology developed at the General American Oils Ltd. Joli Fou pilot project located approximately 240 km northeast of Slave Lake in the Wabasca oil sands deposit.

The Joli Fou pilot, the first in situ combustion pilot in the Wabiskaw sand of the Wabasca oil sands deposit, consists of a single seven spot pattern covering 8 hectares which began operations in March 1981 with air injection into the central well. The Wabiskaw sand at the site is 6 m thick at a depth of 360 m. The bitumen viscosity is similar to that of Cold Lake bitumen.

In conjunction with the Joli Fou pilot, a single well steam stimulation test was conducted adjacent to the pilot site to test reservoir steam response.

The pilot operations were terminated in February, 1983 and the results are being analyzed to determine if further tests in the area are warranted.

1.7 AOSTRA - CDC/Tenneco Kearl Lake Pilot Project

This pilot is located 77 km northeast of Ft. McMurray, and is operated by CDC Oil & Gas Limited. The pilot is testing a steam drive process in the McMurray sandstone which in this area is at a depth of 150 m and about 43 m thick. The pilot consists of an inverted seven spot with 7 steam injection wells and 6 producers. Operations began in December 1981.

AOSTRA acquired a 12 1/2% interest in the pilot as of March 31, 1983.

1.8 AOSTRA - COLD LAKE Heavy Oil Ltd. Preliminary Study

As a result of an application from this Company to carry out a steam plus additives test in Cold Lake a preliminary laboratory and feasibility study was approved at a cost of $600,000.

This study was completed in March and is under review for a decision with regard to a field test.

1.9 Data Base Management System

The AOSTRA Data Base System (ADBS) is a computerized data management system designed to store and disseminate operating data from in situ pilots. The storage format provides for extensive reporting in tabular and graphical form of both raw and processed data. Direct access by computer terminals is available to users.

The system is designed for general industry use through licensing arrangements. During 1982-83 the ADBS provided service to five companies operating six projects, including two non-AOSTRA supported pilots.

Current plans include providing for improved graphical capability and the development of minicomputer packages to facilitate user access to the data base. Modification of storage and access formats to permit use of the system for non-thermal project data is underway. Interfacing with mathematical models in reservoir simulation work is being investigated.

During 1982-83, expenditures on the system were $530,000 and revenues were $420,000, or 83% of expenditures. Cumulative revenues to date equal 52% of costs. It is anticipated that the ADBS will approach a self-supporting basis in the next year or so as more operating problems are overcome and more staff time is available for promotion of the system capabilities to industry.

1.10 Computer Modelling

An agreement to give AOSTRA and Alberta Research Council access and use rights to the Computer Modelling Group mathematical models, in return for AOSTRA/ARC experimental data and a payment of $125,000 per year, was concluded in March. This agreement will run for four years and provides both AOSTRA and ARC with useful tools to analyze pilot and laboratory results.

2. UNDERGROUND ACCESS PROGRAM

Since its inception AOSTRA has been assessing the possibility of extracting the oil from the oil sands from an array of horizontal wells drilled from tunnels within or below the Athabasca deposit.

To gain knowledge of the behaviour of oil sands during tunneling, AOSTRA spent $177,390 in 1977 to install instruments in a water diversion tunnel driven through the oil sands outcrops at Saline Creek near Fort McMurray. In 1979, as a result of a call for proposals to evaluate the relative costs of emplacing horizontal wells from the surface and from shafts and tunnels, AOSTRA and Gulf Canada Resources Inc. jointly funded a study to estimate the cost of building a pilot to do this comparison at the Surmont site south of Fort McMurray. Although the report was encouraging, Gulf declined to continue funding the project. In 1982 AOSTRA selected a new site on Crown land in the Athabasca deposit and commissioned Norwest Resource Consultants Ltd. of Calgary to design and estimate the cost of an Underground Test Facility (UTF), which if built, would provide field experience in shaft sinking and tunneling in oil sands and provide access for the drilling of horizontal wells for an underground thermal in situ recovery pilot. The Norwest report is expected to be completed in April, 1984 and if the cost of the facility is reasonable it could be completed 2 years later. The total funds spent and committed to date for studies and tests of this concept amount to $9.8 million.

3. ENHANCED RECOVERY PROGRAM

Several enhanced oil recovery projects in heavy oil reservoirs, initially funded under the AOSTRA in situ program, are described below in addition to an enhanced recovery project in a conventional light oil pool.

Acquisition of data from one medium gravity fire flood project has been approved and final agreements for this access are being negotiated. In addition two applications for other enhanced recovery projects are under consideration.

3.1 AOSTRA - ALBERTA ENERGY Suffield Heavy Oil Pilot Project

This project, located in the Suffield military block of southern Alberta, is operated by Alberta Energy Company Ltd. on behalf of AOSTRA and the industry participants which in addition to AEC include Dome Petroleum Limited and Westcost Petroleum Ltd. It is located in a glauconitic sandstone and is testing the validity of a wet combustion process in a 19.5 m thick heavy oil reservoir underlain by water. The initial test is an inverted five spot covering two hectares.

Air injection into the central well commenced in February 1982 and is planned to continue for a further three years. Water injection for the wet combustion phase is scheduled to begin in April, 1983.

Water production is substantially lower than forecast and the tendency for wells in this pool to "water cone" early in the well life is not evident in the pilot wells. Production response to the wet combustion is expected during 1983.

3.2 AOSTRA - PETRO-CANADA Viking-Kinsella Pilot Project

This project was originally intended to compare combustion and steam flood performance in a thin (4 m) Lloydminster-type heavy oil reservoir. The steam pattern was suspended at the end of 1981 due to geological problems and generally unsatisfactory performance. Drilling of three new production wells within the air pattern in 1982 changed this configuration to two inverted five spots on a reduced well spacing. This was done in order to obtain earlier response to the combustion process. Although initial combustion problems delayed the drilling of these new wells until late 1982, gas and fluid production is now improving. Wet combustion is scheduled to commence in mid-1983.

The project is scheduled to continue through 1984. This type of reservoir is common in the heavy oil areas of Alberta and the results of this pilot, if successful, will have wide application.

3.3 AOSTRA-Hudson's Bay Caustic Flood Test

Tracer tests were conducted on two wells in the Basal Colorado "A" Pool by Hudson's Bay Oil and Gas Company Limited in mid 1980 to evaluate this pool as a candidate for caustic water flooding. The test concluded that the technique was effective for determining residual oil saturations after a caustic flood. AOSTRA acquired the results of the tests in June, 1981 and the report can be purchased from AOSTRA.

An agreement between Hudson's Bay and AOSTRA provides for potential jointly funded additional field work.

3.4 Heavy Oil Lifting Project

In 1979, AOSTRA and nine oil companies entered into an agreement with Pengalta Research & Development Ltd., a Calgary-based firm, to conduct a review of problems involved in lifting or pumping fluids from heavy oil wells.

The first phase, which included a determination of the state-of-the-art and a definition of the problems, is complete and a report has been submitted. In Phase II, the original ten participants increased to fourteen and $1.75 million was spent on the establishment of experimental facilities to develop solutions to the problems identified in Phase I.

AOSTRA and ten oil companies have agreed to a $150,000 Phase IIIA which provides for field testing the most promising pump design developed in Phase II. Further development of other innovative pumps designed during Phase II is being considered.

3.5 AOSTRA - Norcen Bodo Field, Laboratory Study

This joint project of AOSTRA and Norcen Energy Resources Limited involves laboratory studies on a comparison of steam flooding versus combustion in the Bodo field. This is a low gravity pool (13.5° API) producing from the Manville "B" sandstone located in east central Alberta at a depth of approximately 735 m. Norcen's partners in this project include Canada Cities Service Ltd., Canadian Reserve Oil and Gas Ltd., and Murphy Oil Company Ltd.

approximately 735 m. Norcen's partners in this project include Canada Cities Service Ltd., Canadian Reserve Oil and Gas Ltd., and Murphy Oil Company Ltd.

The laboratory studies and comparative reviews of results are essentially complete.

Norcen and partners are operating a combustion pilot in the field at present. The feasibility of a steam flood pilot, in which AOSTRA may participate, is currently under consideration.

3.6 Cyclic CO_2 Stimulation Project

A joint project with Husky Oil Operations Ltd. involving a series of CO_2 stimulation tests on three wells in the Lloydminster area is nearing completion. The tests were designed to evaluate the production performance of wells following stimulation with large, immiscible slugs of CO_2. Laboratory studies and two single well field tests have been completed in the Lloydminster (Kitscoty) Sparky G pool. Completion of a third and final single well test in the nearby Morgan Lloydminster A pool is anticipated by the end of 1983. The pools are located in east central Alberta in Lower Cretaceous sandstone reservoirs at depths of 600 m. The gravity of oils in these reservoirs ranges from 12 to 16° API. Primary recovery is estimated to be in the order of 1 to 5 percent. The results of the tests conducted on the first two wells and the laboratory studies have been documented in summary reports which can be purchased from AOSTRA. The results of the stimulation test on the third well will be available by the end of 1983.

4. PRODUCED WATER RECYCLING PROGRAM

4.1 Produced Water Treatment Study

Water co-produced with bitumen and heavy oil from in situ recovery operations presents unique problems for disposal and for re-use. However, because of a limited supply of fresh water, it is desirable to recycle any water that may be recovered from in situ production operations. The AOSTRA/Industry Produced Water Treatment Study was set up to evaluate and select the most technically suitable and cost efficient water treatment systems for upgrading various types of produced water to boiler feedwater qualities. The total cost of the preliminary phases of the project have been shared equally among the participants. The upcoming phase will evaluate in detail the most promising processes, and will design a field testing facility. This phase is estimated to cost $555,800. Sixty percent of this cost will be paid by AOSTRA and the remainder will be shared equally among the industry participants. Future work will include construction of the test facility and conduction of field tests of various water treatment systems.

4.2 Application of Ultrafiltration and Reverse Osmosis

AOSTRA has participated with the Walden Division of Abcor Inc. in a series of field tests to examine the application of ultrafiltration membranes and reverse osmosis for treatment of produced water, at a cost of $96,500.

The final report on this project has been received and the results from the field tests have been evaluted relative to conventional water treating processes by an independent contractor. Based on the comparative evaluation, AOSTRA will determine whether there is an incentive for carrying out further research.

4.3 Forced Convection Coil Flow Boilers

The Waterloo Center for Process Development is conducting a bench scale test program to study a process by which the centrifugal forces within forced convection coil flow boilers may be reinforced. The centrifugal forces within the tube coils are used to maintain a thin layer of water on the tube walls which protects against scale formation. AOSTRA has provided funds in the amount of $262,000 to carry out studies into the production of low pressure steam from brackish water, using the concept of reinforced centrifugal forces. Forced convection coil flow boilers are commonly used to generate steam for in situ production of bitumen and heavy oils.

4.4 Microbial Upgrading of Produced Water

Phase 2 of an investigation of the use of micro-organisms to remove hydrocarbons from produced water has been completed by Gemini Biochemical Research Ltd. at a cost of $164,725, and a report was submitted in October 1982. It was found that almost all of the emulsified bitumen and suspended solids could be removed from the produced water by such treatment. Most of the tests were carried out at ambient temperature, but acclimated cultures capable of growth at 60°C were found to give the same high degree of bitumen removal at the expense of a longer residence time. The commercial potential of this approach for oil sands application is now being assessed.

4.5 Francis Hankin Brackish Water Treatment System

In order to reclaim water produced from in situ steamflood projects for use in high pressure utility boilers, a patented system has been developed by Francis Hankin & Co. Limited in Toronto. This system includes electrodialysis, ozonation and dissolved air floation. AOSTRA has committed $353,319 for a field scale test of the Francis Hankin System.

5. SURFACE MINING/EXTRACTION PROGRAM

5.1 XANA (Retco) Electrophoresis Process

AOSTRA continued funding work by Xana Engineering Ltd. in Calgary, to test electrophoretic removal of fine solids from tailings sludge generated by hot water extraction of bitumen from oil sands. By recovering the solids for disposal as a consolidated cake, this process would reduce the size of settling ponds associated with hot water extraction and would increase the amount of clarified water available for recycle.

Based on the results of a laboratory program, a continuous flow pilot plant was constructed and, through an agreement with Syncrude Canada Ltd., tested in Syncrude's Mildred Lake plant. Additional laboratory and bench scale testing has continued in Xana's Calgary laboratory. A technical and economic evaluation of the commercial application of the process is in progress.

AOSTRA's total funding towards the development of this process is $2.0 million.

5.2 UMATAC Dry Retorting Process

AOSTRA and UMATAC Industrial Processes Ltd. have completed a pilot project based on retorting bitumen from oil sands using the Taciuk Processor. The Processor is a proprietary rotating vessel which combines the retorting of the bitumen from the sand, and burning of the deposited coke, within the same vessel. This processor may also be suitable for primary upgrading of heavy oils by using sand as a heat carrier.

Construction of a pilot plant in Calgary was completed in the spring of 1978. In excess of 4000 tonnes of oil sands have been processed in the pilot plant in a successful demonstration of the process concepts.

The second phase of the project, now completed, was designed to investigate specific process parameters, to develop design correlations and to demonstrate the performance of the process by the continuous operation of the pilot plant over extended periods. Two companies, Canstar Oil Sands Limited and Gulf Canada Resources Inc., participated in this phase as consultive participants. The total cost of the pilot project to completion, which was funded by AOSTRA, was $5.3 million.

AOSTRA and UMATAC have now entered into the first phase of a program leading to a large scale demonstration of the Taciuk Processor. During this phase, the preliminary engineering design, and capital and operating cost estimates for a 180 tonne per hour demonstration facility will be developed. A technical and economic comparison of a commercial scale project using the Taciuk Processor with a commercial project using Hot Water Extraction and Fluid Coking will be made. The existing pilot plant will be operated to develop additional design and scale up data for the demonstration facility.

AOSTRA has committed $4.5 million to this Phase I of the demonstration program.

5.3 Lurgi-Ruhrgas Direct Coking Process

In 1976, AOSTRA commissioned a study to evaluate the comparative economics of the Lurgi-Ruhrgas Direct Coking Process relative to the Hot Water Extraction/Fluid Coking Process combination. The study's results prompted the Authority to fund pilot testing of the LR-Process by Lurgi in Essen, West Germany. The test runs were completed in December, 1980, at a cost to AOSTRA of approximately $507,000. The pilot work failed to confirm the performance predictions used in the 1976 study; the comparative economics are being re-evaluated on the basis of the test results to determine whether further research by AOSTRA on the LR-Process is warranted.

5.4 RTR Oil Sands Extraction Process

The RTR Process is a modified hot water extraction process that offers mild oil sands conditioning and internal water recirculation which may result in improvements in thermal and mechanical efficiencies relative to the conventional hot water process. A solvent/water contacting device is employed to remove residual solids and water from the primary froth, yielding a diluted bitumen product.

AOSTRA entered into an agreement with Gulf Canada Resources Inc. and RTR-Rio Tinto Til Holding, S.A. to receive data from a pilot project located at the Suncor Inc. plant site. The results of the field tests have been received and are being evaluated.

AOSTRA's commitment to this project was $100,000.

5.5 Kruyer Oleophilic Sieve Extraction Process

Kruyer Research & Development Ltd. of Edmonton has developed a novel method of separating bitumen from mined oil sands by means of an oleophilic sieve. This device captures the bitumen on the coated surface of a perforated continuous belt while allowing water and solids to pass through the openings. The Process may provide higher bitumen yields and higher thermal efficiencies than the Clark Hot Water Process. AOSTRA has provided $340,000 to Kruyer to construct and operate a small pilot on low grade (high clay content) oil sands. This test has been concluded. A final report of the results of the pilot plant tests has been received and is available from AOSTRA. An alternate use for the Kruyer Process to recover hydrocarbons from tailings generated by hot water extraction of bitumen is being considered.

5.6 Porta Plants Inc.

Porta Plants Inc., of Salt Lake City, Utah, has developed a water based process for extraction of bitumen from oil sands. Preliminary results from tests on Utah and Athabasca oil sands have shown acceptable bitumen recovery and the ability to recycle a larger fraction of the process water than is possible with the Clark Hot Water Extraction Process. AOSTRA has provided $10,000 (U.S.) to Porta Plants for a small pilot plant test of the process on low grade (high clay content) Athabasca oil sands.

5.7 Proposed Oil Sands Demonstration Centre

Testing of new oil sands mining and extraction technologies, on a scale large enough to demonstrate the technical and economic viability of new equipment and processes, is a costly and difficult procedure due to the large quantitites of feed required, and the need for extensive support facilities.

AOSTRA, in conjunction with eight companies holding mineable oil sands leases and the Federal Department of Energy, Mines and Resources, is investigating the feasibility of constructing an Oil Sands Demonstration Centre in the Fort McMurray area of Alberta. This Centre would be a cooperative, shared-cost facility to accommodate large-scale, long-term testing of new technologies that would be applicable to mined oil sands.

Conceptual design and preliminary cost estimates have been prepared. Negotiations are currently underway to gain access to a preferred site for the Centre and to secure a source of oil sands feed to be supplied to potential users, for test purposes.

The first potential user of the Centre has been identified and it is planned to carry out sufficient detailed engineering of the Centre, based on the needs of this user, to permit the preparation of definitive capital and operating cost estimates. Incentives for industrial participation in the Centre are being developed with the Alberta Government.

AOSTRA's commitment to the total cost of the project to completion of the current phase, in which all of the participants share equally, is $43,000.

5.8 Hydraulic Dredging Tests

The costs associated with overburden removal and mining of oil sands are major components in the total cost of production from surface-mineable oil sands. Hydraulic dredging has been proposed as one method of reducing mining and transportation costs for both overburden and oil sands. In 1982, AOSTRA and Petro-Canada Exploration Inc., jointly funded a test program consisting of model cutter section dredging tests on both lean and rich oil sands, pumping tests to identify hydraulic transportation characteristics of overburden and oil sands, and cutting tests to determine forces required to cut siltstone found in overburden. These tests were conducted by the Delft Hydraulic Laboratories, at the Delft University of Technology in Holland. The results from the tests have been received and are being evaluated.

AOSTRA's commitment to the project was $175,000.

6. UPGRADING RESEARCH PROGRAM

6.1 Upgrading to Petrochemical Raw Materials

Conventional petroleum fractions for making petrochemical starting materials such as ethylene are expected to become scarce and costly. The use of oil sands bitumen as a cracking feed for this purpose offers a plentiful supply of lower cost feed materials and an opportunity for substantial upgrading in value of certain components of the product over transportation uses.

AOSTRA and Mitsubishi Petrochemical Co. Ltd. of Japan have completed testing a direct thermal cracking technique for the production of ethylene and other petrochemical feedstocks from bitumen. The program was carried out by the Alberta Research Council with technical assistance from Mitsubishi.

Two Alberta companies have expressed an interest in the process in the long term, but are unable to commit to further evaluation and testing at this time. AOSTRA is negotiating with Mitsubishi to obtain performance data from the operation of a 120 tonne per day pilot in Japan. It is planned that this data would be made available by AOSTRA to industry for future analysis and evaluation of the technology at a more appropriate time.

6.2 Heavy Oil and Bitumen Upgrading Study

AOSTRA and twelve industrial participants have undertaken a study to evaluate alternatives to current commercial technology for upgrading bitumen or heavy oil. These alternatives have the potential to improve liquid yield, or energy efficiency, reduce environmental impact and improve economic viability.

The study, now being completed by Acres Davy McKee Ltd., provides a consistent basis for technical and economic evaluation of these evolving processes. The cases studied include a large scale oil sands mining project and both large and small scale in situ projects. The evaluation phase is expected to be complete by September, 1983, at a project cost of $3.4 million, one half of which is being borne by AOSTRA.

The ultimate goal of this program is to demonstrate new and improved technology on a scale large enough to reduce the risk when it is used in a commercial application. This demonstration phase will depend on the recommendations of the evaluation phase, the justification for a demonstration and the continued support of potential industrial users.

6.3 Application of Coal Processing Technology to Bitumen Upgrading

Catalytic Inc. of Philadelphia, Pennsylvania, has completed a project to test the application of coal liquefaction technology to bitumen upgrading. Small scale testing of supercritical solvent extraction of bitumen followed by hydrogen donor solvent of the extracted residue demonstrated that these processes could be used to upgrade bitumen. AOSTRA has completed an evaluation of the test results and concluded that the yield and quality improvements did not provide sufficient incentive for AOSTRA to carry out further research on this upgrading option.

6.4 Thermal Conversion Process for Bitumen Upgrading

A new, high conversion thermal cracking process which incorporates steam stripping of the crackate, and which yields a liquid pitch residue, has been developed and used commercially in Japan. This process is called the Eureka Process.

AOSTRA has entered into an agreement with Mitsui & Co. Ltd., Kureha Chemical Industry Co. Ltd., and Chiyoda Chemical Engineering & Construction Co. Ltd., to test the performance of this process on Athabasca and Cold Lake bitumen feeds in an existing pilot plant in Japan. The test work associated with this $433,755 project has been completed and the final report has been received. Canstar Oil Sands Ltd. participated with AOSTRA in this project, paying twenty percent of the project cost. The main conclusion from this test program is that Athabasca bitumen and Cold Lake bitumen are excellent feeds for the Eureka Process.

6.5 Dynacracking

AOSTRA has agreed to participate in the Calsyn joint venture for the construction and operation of a demonstration Dynacracking unit in California. This process combines cracking and gasification in one vessel and offers the potential to upgrade heavy oils to liquid and gas products without the production of residue. AOSTRA has agreed to fund 10% of the project costs to a maximum of $5 million U.S.

Through participation in the project, AOSTRA would be entitled to process Alberta feedstocks for test purposes and receive revenue from project and license income.

The US Synthetic Fuels Corporation will provide loan guarantees for 60% of the cost of the project.

6.6 Resource and Energy Management System (REM)

The REM System is a concept for the integration of processes and operations to obtain maximum liquid products from upgrading bitumen and heavy oils, and at the same time obtain maximum utilization of energy.

In 1981, AOSTRA, in co-operation with Norcen Energy Resources Limited, and the Federal Department of Energy Mines and Resources, undertook a technical and economic evaluation of the REM system as applied to small scale plants. The final report from the evaluation has been received and is being reviewed. AOSTRA's commitment to the evaluation was $125,000.

6.7 British Columbia Research Council - Fluidized Bed Coke Combustion

In 1982, British Columbia Research Council undertook to study the combustion of Syncrude Canada Ltd. fluid coke in their fluidized bed pilot unit. The objectives of the project were threefold: to determine the effects of limestone addition on SO_2 emissions, to test the leachability of the ash, and to assess the corrosion of common boiler tube alloys in the combustor. AOSTRA committed $84,570 to this project, which is now in the final stages.

6.8 AOSTRA/Industry Upgrading Residue Utilization Project

Most processes designed for the upgrading of bitumens or heavy crude oils produce residual streams which must be utilized in an environmentally acceptable and economically feasible manner. AOSTRA and nine industrial participants have initiated the first phase of a cooperative project to identify and evaluate technologies that can upgrade such residues. After the most promising methods of utilization have been identified, it is planned to test these technologies on residues produced from Alberta bitumens and heavy oils.

The project is currently in the organizational phase. Detailed cases are being developed for evaluation in the next phase of the project, a contractor is being selected to perform the evaluation, and a project agreement is being negotiated. The cost of the first phase of the project, which is estimated to be $90,000, is being shared equally among the participants.

7. UNIVERSITY PROGRAM

7.1 Professorships

In the past eight years AOSTRA has appointed nine professors to chairs at Alberta universities to carry out advanced research on oil sands problems. The term of each initial appointment is 3 years, renewable for a further term of 2 years. The incumbent professors may also apply for additional funds for specific research projects.

The current incumbents are involved in the following research projects:

i) Dr. L.G. Hepler of the University of Lethbridge is investigating clay/oil/water systems encountered in many aspects of the oil sands industry and is also measuring specific heats of various components of oil sands and heavy oil deposits.

ii) Dr. E.C. Pielou of the University of Lethbridge is investigating the impact on the environment of oil sands development. Studies are to be carried out in the areas of reclamation and pollution.

iii) Dr. J.D. Scott of the University of Alberta is using analytical modelling techniques and laboratory and field experimental studies to increase basic knowledge on the geotechnical properties of oil sands.

iv) Dr. T.J.T. Spanos of the University of Alberta is working on the mathematical simulation of in situ recovery processes, with emphasis on the fundamental equations that describe the dynamics of fluid flow and displacement.

v) Dr. O.P. Strausz of the University of Alberta is investigating the chemistry of the Alberta oil sands bitumens, with particular emphasis on the heavier fractions.

vi) Dr. E.L. Tollefson of the University of Calgary is investigating the desulphurization of coke and the relative fuel values of some constituents of oil sands.

These professors devote approximately three-fourths of their time to oil sands research. The total funds committed to date for the professorship program is $2.1 million.

7.2 Graduate Scholarships and Fellowships

The program to provide Scholarships and Fellowships for oil sands research at the University of Alberta, the University of Calgary and the University of Lethbridge has been extended for an additional 4-year period to provide for 8 new Fellowships and 25 new Scholarships.

The Scholarships are for a maximum period of two years and the research carried out will normally lead to either a Masters or Doctoral degree. Fellowships are for three years and are intended to assist post-doctoral level scientists to further their research training. Many of these individuals will eventually undertake industrial research. Current award holders are:-

UNIVERSITY OF ALBERTA	*UNIVERSITY OF CALGARY*	*UNIVERSITY OF LETHBRIDGE*
Agar, J.G.	Kulkarni, T.G.	*Campbell, J.S.
Chan, S.M.	*Ladd, T.I.	
*Cyr, T.G.	Lim, S.I.	
Harding, T.G.	Maier, R.	
Hiebert, A.D.	Oltman, P.	
Korpach, D.R.	Mensforth, M.A.	
Kowalulchuk, K.K.		

*Fellowship

7.3 University Research Projects

Results of much of the earlier research conducted in universities with support from AOSTRA has been published or is being published in various technical journals or books. Results of more recent research, and of on-going research, can be obtained through AOSTRA's University Access Program.

Research in universities has led to two patent and three patent applications. Use rights to the patents may be licensed from AOSTRA.

Current projects are described briefly below:

(1) Dr. F.W. Bachelor of the University of Calgary has been investigating the nitrogen-and oxygen-containing compounds in bitumen. This research has been funded with a total of $376,593 over 7 years.

(2) Dr. D.W. Bennion and associates at the University of Calgary have carried out extensive investigations of the combustion of oil sands and the low temperature oxidation of bitumen, funded to a total of $1,150,000 over a period of 7 years.

(3) Dr. P.M. Boorman and colleagues at the University of Calgary are investigating the catalytic desulphurization of bitumen. The support for these projects has amounted to $282,800 over 6 years.

(4) Dr. P.M. Byrne and Dr. Y.P. Vaid of the University of British Columbia have worked on a method for predicting stress-strain relationships and related stabilities of oil sands, with particular emphasis on conditions appropriate to various excavations. This work has been supported with $30,000 for 1 year.

(5) Dr. F.S. Chute and Dr. F.E. Vermuelen of the University of Alberta are measuring electrical properties of oil sands, developing physical models of electrical heating methods, and evaluating the use of electrical power for selective heating of oil sands. Their research has been funded for $369,573 over a 7 year period.

(6) Dr. J.E. Desnoyers of Université de Sherbrooke is developing methods for investigating phase equilibria and other properties of oil-water microemulsions, with a view toward use of microemulsions for extraction of bitumen and heavy oil. These investigations have been supported by $275,774 over a period of 5 years.

(7) Dr. M.B. Dusseault of the University of Waterloo is investigating properties of clay shales from the Clearwater formation in relation to dredging of overburden and disposal of sludge-overburden mixtures. This 1 year project will cost $16,787.

(8) Dr. S.M. Farouq Ali of the University of Alberta has been investigating mathematical modelling to simulate the opening and closing of fractures in cyclic steam stimulation systems. He has also been investigating the utilization of emulsion flooding for the recovery of Cold Lake and Lloydminister heavy crudes. These projects have been funded to a total of $248,272 over 4 years.

(9) Dr. D.L. Flock of the University of Alberta is studying the effects of additives in steam on the degree of emulsification of oil in water and the relationships of these effects to overall recovery by cyclic steam stimulation and steam displacement. This is a 3 year project costing a total of $300,000.

(10) Dr. J.E. Gillott of the University of Calgary is investigating the changes in strength, dimensions, permeability, and bond characteristics of oilwell cements after hydrothermal treatment in the presence of formation fluids and drilling muds. This is a 2 year project costing $69,689.

(11) Dr. E.M. Gates and Dr. R. Toogood of the University of Alberta are investigating the cutting of oil sands by high pressure water jets. Total funding for this research and earlier related research begun by Dr. R. Gilpin is $78,157 over 4 years.

(12) Dr. L.G. Hepler of the University of Lethbridge has investigated colloidal and thermodynamic properties of various clay, oil, and water systems and is also measuring specific heats of minerals and oils from several oil sands and heavy oil deposits. Funding has amounted to $328,304 over 7 years.

(13) Dr. I.E. Hutcheon at the University of Calgary is investigating rock-oil-water interactions in heavy oil systems, with particular emphasis on the carbonate deposit. This 2 year project will cost $154,020.

(14) Dr. J.B. Hyne of the University of Calgary has been investigating the reactions of bitumen, emphasizing sulphur-containing compounds, with water at high temperature and pressure, comparable to in situ recovery conditions. Petro-Canada Exploration Inc. and INTEVEP of Venezuela have purchased access to this program by paying 25% and 50%, respectively, of the cost and are participating in technical planning. This project has been funded for $1,106,621 over a 7 year period.

(15) Dr. A. Jeje of the University of Calgary is measuring the rate of carbon dioxide mass transfer into films of oil supported on glass or silica plates to obtain background information on the influence of film thickness and the role of the supporting surface upon the rate of carbon dioxide transfer into the hydrocarbon film. This is an 18-month project costing $42,320.

(16) Dr. F.W. Jones and Dr. J.S. Rogers of the University of Alberta are working on the development and application of an improved tilt-meter as a method for following the progress of in situ recovery processes. This 3 year project will cost $183,257.

(17) Dr. G.A. Karim of the University of Calgary has investigated several problems related to the combustion of bitumen associated with sand grains. This research has been funded for a total of $82,612 over 4 years.

(18) Dr. N. Kosaric of the University of Western Ontario is investigating the use of bacteria and bacterial products for breaking emulsions that are formed during production of bitumen and heavy oils, at a cost of $76,147 over 13 months.

(19) Dr. H.R. Krouse of the University of Calgary is directing a program designed to provide gas chromatography/mass spectrometry and stable isotope/mass spectrometry analytical facilities, along with new methods of analysis. Funding is $248,040 over a 5 year period.

(20) Dr. D.G. Lee of the University of Regina has conducted an exploratory investigation of the chemical reactions of certain components of bitumen, with a view toward the possible development of new upgrading or analytical methods. This project has been supported with $8,000 for 8 months.

(21) Dr. F.J. Longstaffe of the University of Alberta has worked on the characterization of clay minerals associated with three different grades of oil sands. This 8 month project cost $16,668.

(22) Dr. A.K. Mehrotra of the University of Calgary is studying the treatment of in situ produced water for recycling to boilers. This one year project is for $17,136.

(23) Dr. M.F. Mohtadi of the University of Calgary studied the development of a process for recovery of heavy oil from reservoirs involving the downhole generation of steam. This research has been supported for 15 months at $63,659.

(24) Dr. N.R. Morgenstern and Dr. J.D. Scott of the University of Alberta have designed and set up a high temperature, high pressure test facility and are using the facility to measure strengths, deformabilities, and permeabilities of oil sands at temperatures and pressures encountered in in situ production. This work has been funded to a total of $92,160 over a 2 year period.

(25) Dr. E.W. Neumann of the University of Toronto has developed a new method for investigating interfacial tensions, which is being applied to oil sands systems. Funding for this research is $240,479 over 4 years.

(26) Dr. E. Nyland of the University of Alberta is testing a field-oriented microseismic monitoring array for monitoring oil sands and heavy oil in situ recovery processes. This project will cost $282,300 over a 2 year period.

(27) Drs. F.D. Otto, I.G. Dalla Lana and S.E. Wanke of the University of Alberta, are characterizing and evaluating the performance of catalysts for the hydroprocessing of heavy oils from Alberta petroleum resources. The two year project is funded for $252,877.

(28) Dr. H. Pascal, at the University of Alberta, is working on a new method for measuring steam quality and mass flow for steam-based in situ recovery. Funding for $50,000 for 1 year follows earlier funding to Dr. Rankin and Dr. Pascal in the amount of $90,360 for 28 months.

(29) Mr. E. Peake of the Kananaskis Center for Environmental Research at the University of Calgary is assessing environmental hazards and human health risks that might arise from toxic and carcinogenic substances that could be generated during in situ fireflood production from oil sands. Funding for this research has been $217,000 over 2 years, with costs shared equally between AOSTRA and Alberta Environment.

(30) Dr. E.C. Pielou of the University of Lethbridge is investigating possible effects of sulphur dioxide emissions on plant life. Her work involves both field testing and controlled-atmosphere greenhouse experiments. Funding is for $102,625 for 2 years.

(31) Dr. D. Rankin of the University of Alberta is investigating application of the magnetotelluric method for flame front detection in in situ combustion, funded with $161,460 over 4 years.

(32) Dr. R.E. Robertson of the University of Calgary has carried out an extensive range of investigations of emulsions, funded for a total of $415,338 for a 7 year period.

(33) Dr. D.B. Robinson of the University of Alberta is measuring phase relationships of bitumen with gases, liquids, and steam under conditions of in situ recovery. This research has cost $250,720 over 3 years.

(34) Dr. R.S. Roche of the University of Calgary is investigating the energetics, kinetics, and catalysis of pyrolysis (cracking and coking) of bitumen. This research will cost $689,923 over 7 years.

(35) Dr. T.S. Sorensen of the University of Calgary is directing a chemical investigation of hydrotreating bitumen under various conditions of temperature, pressure, and catalyst type. This project is for $252,378 over 4 years.

(36) Dr. T.J.T. Spanos of the University of Alberta is conducting mathematical analyses of fluid flow properties in relation to in situ production. This research will cost $81,410 over a 2 1/2 year period.

(37) Dr. P.C. Stangeby of the University of Toronto is investigating the use of a rapid-heating hydroyrolysis procedure for upgrading bitumen. This 4 year project will cost $228,319.

(38) Dr. O.P. Strausz and Dr. D.S. Montgomery at the University of Alberta are directing three continuing research projects which involve different aspects of the chemistry of bitumen. One project is a detailed investigation of the asphaltene and resin fractions of bitumen. Another project is directed at possible improvements in upgrading processes for bitumen. A third project involves investigation of the causes of poor separability of bitumen from low grade oil sands. Total funds spent and committed in the period 1977-1985 amount to $2,195,184.

(39) Dr. W.Y. Svrcek and Dr. A.K. Mehrotra of the University of Calgary have been measuring the solubilities of gases in bitumen and the viscosities of the resulting gas-bitumen solutions. Total funding has been $398,860 over a period of 6 years.

(40) Dr. E.L. Tollefson of the University of Calgary has been investigating the technology and economics of desulphurizing oil sands coke. Funding for this research has been $48,930 (8 months) and $124,302 (1 year).

(41) Dr. R.E. Verrall of the University of Saskatchewan is using ultrasonic absorption methods for investigating the dynamics of surfactants in ternary and quaternary microemulsions. This research has been funded for $47,020 over a 2-year period.

(42) Dr. R.C. Von Borstel of the University of Alberta is directing an evaluation of the possible mutagenicity of various process streams resulting from in situ pilot projects and bitumen refining operations. This project has been funded at $198,668 over 3 years.

(43) Dr. J.K.S. Wan of Queen's University is investigating the use of microwave induced catalysis in various processes for upgrading bitumen. Total funding is $120,240 for 26 months.

(44) Dr. N.C. Wardlaw of the University of Calgary is investigating rock-pore properties in carbonate and sandstone reservoirs in relation to enhanced oil recovery. This project is funded with $146,000 over a 2 year period.

8. AOSTRA/ALBERTA RESEARCH COUNCIL PROGRAM

AOSTRA continues to support various programs at the Alberta Research Council (ARC). These programs are described below:

8.1 Oil Sands Laboratory Research

ARC is conducting a substantial portion of AOSTRA's laboratory type research at its Oil Sands Research Department. Since April 1, 1981, AOSTRA and ARC have signed a new five year agreement to conduct a joint research program. A total of 5 million dollars was expended during the second year (1982-83) of the program. AOSTRA contributed 60% of the total cost ($3.0 million) and ARC the remainder. The major portion of the program includes investigation of the benefits from the addition of various additives, such as gases, solvents and surfactants to the injected steam by using physical test bed simulators, developing numerical models, determining physical parameters, studying physical chemistry of interfacial phenomena and hydrothermal chemistry of fluid-rock interactions, and developing bitumen upgrading processes. Some notable accomplishments achieved during 1982/83 are summarized as follows:

8.1.1 Fifteen runs were carried out on the 60 cm. physical simulator with the following results being of major importance:

- In a series of runs, a cyclic steam-flue gas process was simulated at two flue-gas concentrations. A marked improvement in recovery over a steam only process was demonstrated for both concentrations.
- In a number of trials the CO_2-steam process was studied over a range of pressures and with varying oil sands quality. The bitumen recoveries obtained were unaffected by pressure but markedly influenced by oil sands quality. The CO_2-steam process gave better recoveries on low quality oil sands than a steam only process.

8.1.2 Researchers at ARC have found a way to prevent surfactants from degrading at the high temperatures of the steam and losing some of their effectiveness. Based on this finding, it is believed that the steam-surfactant process is close to readiness for field trials.

8.1.3 The results from the study of surface properties of bitumen and the forces acting at the bitumen-water interface have been successfully applied to develop an improvement to a caustic flood process.

8.1.4 A two-component thermal recovery numerical model has been extended to four components so that the capability of modeling steam-additive processes is significantly improved. The model can be used to assess the effectiveness of different recovery schemes.

8.1.5 A thermochemistry laboratory was established. The first phase of a program to utilize the available low temperature data to describe important high temperature reactions which take place in a steam recovery process was completed.

8.1.6 Several new systems and apparatus have been developed to extend the ability to study reservoir fluids and the bitumen-water interface:

- An x-ray technique to map the bitumen and water movement in displacement experiments at recovery temperatures and pressures.
- A novel, laser-Doppler velocity meter was designed and built to measure the surface properties of bitumen suspensions with much more precision and speed than possible with conventional methods and instruments.
- A high temperature and high pressure viscometer was designed and constructed. The viscometer is capable of working at subsaturation gas concentrations and can be used to measure the viscosity of bitumen-additive viscosities under recovery conditions. The results and are being incorporated into the numerical model mentioned previously.

In addition to the technical achievements reported above, an industry access program was established and implemented allowing industry to subscribe on an annual basis to the work carried out under the joint research program. Despite the downturn in the economy, four companies are participating in the program.

8.2 Sample Bank

During the second year of the three-year contract, AOSTRA provided the Sample Bank with $218,385 to continue their services such as collection, storage, distribution, analyses and evaluation of various oil sands and bitumen samples. The Sample Bank shipped 104 tonnes of oil sands in 1982/83, (170 individual samples), to various petroleum research laboratories around the world. The shipments of oil sands samples increased by 13% as compared to the previous year.

8.3 Geology

In early 1980 AOSTRA agreed to provide $1,915,000 to the Alberta Research Council to conduct regional geological studies in oil sands, carbonate and heavy oil areas. To carry out this work ARC has increased its professional and technical staff and will make the services of certain senior personnel available. The contract provides for work to continue over a four year period.

The initial work involved a technical audit of geological data available from AOSTRA's industrial participants. This work has been completed and forms the basis for the regional studies which are continuing in the Athabasca, Cold Lake and Carbonate reservoirs. A detailed geological study of the Suffield Block also has been completed.

A detailed report on possible locations for a new pilot in the Gregoire Lake area of Athabasca has been prepared.

An ARC geologist has been assigned to the technical committee of each AOSTRA field pilot.

Assistance was provided in evaluating applications for field projects in Athabasca, Wabasca and Cold Lake.

8.4 Oil Sands Information Centre

AOSTRA agreed with ARC to continue to fund the Alberta Oil Sands Information Centre (AOSIC) for five years beginning May 31, 1980 with a total budget of $2.1 million. In addition to the continuation of its services of collecting and disseminating information related to oil sands, AOSIC has expanded its information services on enhanced oil recovery and heavy oil.

AOSIC currently publishes quarterly the Alberta Oil Sands Index (AOSI) and the Heavy Oil/Enhanced Recovery Index (HERI) and provides on-line access to both computerized AOSI and HERI databases with bi-weekly updated awareness information series. The Centre continues to publish and distribute its newsletter "Tar Paper" to interested people in the oil sands and heavy oil fields.

In 1982/83, AOSIC had 32 online users with access to both databases, 54 AOSI subscribers and 23 HERI subscribers.

9. PROGRAMS AT OTHER RESEARCH INSTITUTES

9.1 Petroleum Recovery Institute Program

In the 1981-82 fiscal year, AOSTRA made provision for the expenditure of $300,000 by the Petroleum Recovery Institute in Calgary for engineering studies of enhanced oil recovery (EOR) possibilities in Alberta. Enhanced oil recovery processes are sensitive to reservoir conditions and to rock and fluid parameters. The research program is directed towards identifying suitable locations for tests of particular EOR processes.

One of these projects resulted in a field test by AOSTRA and an industry partner.

A combined engineering/geological study of enhanced recovery methods in the Pembina Cardium pool was approved for funding by AOSTRA and will be started in the second quarter of 1983. The cost of this project is estimated at $330,000.

In addition to providing support for specific projects, AOSTRA will in the future be matching the industry grants for the core facilities of PRI, which previously had been provided by the Department of Energy & Natural Resources.

9.2 British Columbia Cancer Foundation Program

AOSTRA is providing support to the Carcinogen Testing Laboratory of the British Columbia Cancer Foundation to evaluate the use of mammalian cells in genotoxicity testing of oil sands process streams and related materials. The budget for the study is $125,000 over two years. Samples from various AOSTRA supported pilot projects are assayed for the capacity to induce chromosome and DNA damage in Chinese hamster ovary cells and human skin fibroblasts respectively. The entire study is aimed at developing a relevant system for making human carcinogenic risk assessments.

10. INTERNATIONAL PROGRAM

During the year, it was decided to increase the emphasis on international activities through the formation of a new directorate which would have two main responsibilities; coordination of all technology transfer and implementation of international programs. Over the past year, this group has been in contact with a large number of organizations outside Canada for the purpose of promoting cooperation in the exchange of data and in the development of heavy oil technology (including both production and upgrading technology). The utilization of Alberta private sector expertise and services was also promoted widely.

Memoranda of Understandings were formalized between AOSTRA and PETRO PERU and between AOSTRA and the Daqing Petroleum Administration Bureau in Heilongjiang, People's Republic of China. In addition, discussions and exchanges of communications were held during the year with representatives from the following countries.

- Argentina
- Bahrain
- Brazil
- Ecuador
- Germany
- India
- Italy
- Japan
- Kuwait
- Madagascar
- Nigeria
- People's Republic of China
- Peru
- Romania
- Thailand
- Trinidad and Tobago
- United States
- Venezuela

AOSTRA representatives visited the following countries for the activities indicated;

Brazil - for meetings related to crude oil extraction processes from surface deposits

Japan - to participate in a synfuels conference

Madagascar - for meetings in regard to crude oil extraction and upgrading

People's Republic of China - to sign a letter of cooperation and to attend a U.N. - sponsored conference on production practices

Trinidad and Tobago - to study heavy oil field operations and to attend meetings of UNDP/ UNITAR World Information Centre

United States - to review progress of the joint Canada/U.S. experimental program

One joint international experimental program commenced during the year and another is in the final stages of negotiation. The on-going program is with the United States Department of Energy and provides for United States and Canada to each spend $600,000 investigating the use of additives to steam for in situ recovery processes. The D.O.E. is to carry out small scale screening studies (this program is underway) and Canada is to follow up with more definitive tests of the most promising additives. One-third of the Canadian contribution will be paid by each of AOSTRA, the Saskatchewan Department of Mineral Resources and the Federal Department of Energy, Mines and Resources.

A second program will be between AOSTRA and INTEVEP of Petroleos de Venezuela and will include a coordinated program of testing of the properties of Canadian and Venezuelan crudes plus joint work in numerical modelling.

The new cooperative relationship between AOSTRA and the People's Republic of China has been very active. Two small AOSTRA delegations have visited China to arrange for future activities and two technical delegations from PRC have visited Alberta. The first PRC delegation finalized arrangements for cooperation in areas of mutual interest and the second consisted of two 5-man teams who studied, under AOSTRA sponsorship, winter operations in the transportation, drilling and workover areas of crude oil production.

11. TRAINING PROGRAM

11.1 Master's Program in Oil Sands Engineering

The Master's in Oil Sands Engineering degree program was established in April, 1980 to make well-qualified, technical personnel available for the oil sands industry.

The program is supported by AOSTRA and is operated cooperatively with industry. Students with engineering or science degrees, but without experience in oil sands, spend four months at the University, a period of twelve months working in industry and a final four month term at the University. AOSTRA provides financial support during the University study periods.

The program continued during 1982 but with a reduced enrollment. As a result of the recession, it was not possible to find sufficient industries willing to take the students for the work term.

It has been decided not to offer the program for 1983/84. It is hoped that it will be possible to develop a modified program for September 1984.

During the 1982/83 fiscal year $215,445 was spent on the Masters program. This amount covered academic support for twelve students and employee wages for 4 students (3 in the AOSTRA offices and 1 at the Alberta Research Council).

11.2 University Summer Students and Co-Operative Program

AOSTRA has had the policy of employing students from Canadian universities for temporary positions during the summer and, in the case of the co-operative programs, at other times in the year. These work periods provide students with valuable work experience in the oil sands field.

During the 1982/83 fiscal year, AOSTRA employed three summer students at a cost of $20,115 and 6 co-operative students at a cost of $43,853.

12. METHODS OF ACCESS TO ONGOING AOSTRA PROJECTS

AOSTRA continues to maintain its policy of making its technology available on a cost sharing or a fair market value basis. During the year ending March 31, 1983, $2.9 million was received by AOSTRA from the sale of technology rights.

12.1 Joint Industry Projects

The current economic downturn has reduced interest in the purchase of information from projects in which AOSTRA is participating. Information was, however, provided from two projects, the AOSTRA/Union Oil Carbonate Thermal Pilot and the UMATAC Dry Retorting Process for extracting and upgrading oil from the oil sands. It is expected that there will be numerous sales of technology after the return to a more attractive investment climate.

12.2 University Research Projects

The interest by industry in obtaining the results of the University research has been maintained. The current number of industry supporters (13) testifies to the quality and usefulness of the results from the program. In spite of cash flow problems, the companies believe that it is desirable and worthwhile to have early access to the latest university research as well as the opportunity to consult with the researchers.

12.3 The Joint AOSTRA/ARC Laboratory Program

This year for the first time, the opportunity was provided for industry to access the results from this laboratory program. Four companies have joined to date.

It is expected that the participation of operating companies will substantially enhance the effectiveness of the experimental program.

12.3 The Data Base Management System

This system is now fully operational and its use by industry resulted in a cumulative income of $677,000. The system is available to all companies for storing and retrieving pilot data on a confidential fee-for-service basis. The system can manipulate data in numerous ways and is particularly useful for generating routine reports as well as graphs and tabulations.

13. PATENTS

13.1 AOSTRA Patents

The following patents and patent applications are assigned to AOSTRA:

a) U.S. Patents

U.S. Patent No.	Date Issued	Patent Title
4,180,455	Dec. 25/79	Process for Thermal Cracking a Heavy Hydrocarbon (W. Taciuk)
4,280,879	July 28/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
4,306,961	Dec. 22/81	Process for Recovery of Hydrocarbons From Inorganic Host Materials (W. Taciuk Tarsand Version)
4,285,773	Aug. 25/81	Apparatus and Process For Recovery of Hydrocarbons from Inorganic Host Materials (Taciuk Lloydminster Version)
4,312,234	Jan. 26/82	Two Phase Flow Meter (D.S. Scott and E. Rhodes)
4,271,905	June 9/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen From Tar Sands (D.A. Redford and M.R. Hanna)

b) U.S. Patent Applications

U.S. Patent Application No.	Date Filed	Patent Application Title
06/330,162	Dec. 14/81	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
06/286/843	July 27/81	Catalytic Sulphur Removal from Hydrocarbons (P.M. Boorman et al)
06/229,349	Jan. 29/81	Wet Combustion Process (D.W. Bennion et al)
06/294,523	Aug. 20/81	Variable Speed Pump Jack (D.L. Buckler)

c) Canadian Patents

Canadian Patent No.	Date Filed	Patent Title
1,120,418	Mar. 23/82	Process and Apparatus for Thermally Processing Heavy Hydrocarbon Containing Liquids (W. Taciuk)
1,121,749	Nov. 12/79	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
1,102,234	June 2/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen From Tar Sands (D.A. Redford and M.R. Hanna)
1,122,015	Apr. 20/82	Process for Microbiologically Leaching Coke (T.R. Jack et al)
1,129,801	Aug. 17/82	Alkali Recycle Process for Recovery of Heavy Oils and Bitumens (M.A. Kessick)
1,134,174	Oct. 26/82	Two-Phase Flowmeter (D.S. Scott/E. Rhodes)

d) Canadian Patent Applications

Canadian Patent Application No.	Date Filed	Patent Application Title
369,403-8	Jan. 27/81	Wet Combustion Process (D.W. Bennion, R.G. Moore & J.K. Donnelly)
378,386-3	May 26/81	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
369,403-8	July 7/81	Wet Combustion Process (D.W. Bennion et al)
383,910-9	Nov. 6/81	Variable Speed Pump Jack (D.L. Buckler)

e) Venezuela Patent Applications

0067	Jan. 21/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1933	Oct. 31/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)
108/82	Jan. 22/82	Wet Combustion Process (D.W. Bennion et al)

f) Mexico Patent Applications

179,758	Oct. 24/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)

g) European (EEC) Patents

0-028-666 (Belgium, France, Italy Netherlands and U.K.) 79.302542.0 (Sweden) 29-65-154.5 (Germany)	Apr. 6/83	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)

h) Argentina Patent Applications

279,427	Dec. 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)

i) Romania Patent Applications

99095	Oct. 30/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)

j) Turkey Patent Applications

14426	Dec. 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)

k) Japan Patent Applications

138227/79	Oct. 25/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon - Containing Liquids (W. Taciuk)
172665/81	Oct. 28/81	Two-Phase Flowmeter (D.S. Scott/E. Rhodes)

13.2 Prior Company Patents

(for which AOSTRA has acquired certain Licensing Rights)

a) U.S. Patents

	U.S. Patent No.	Date Issued	Date Filed	Riested Canadian Patent No.	Patent Titles
1.	3174544	4-01-65	5-15-64	-	Recovery of petroleum by combination reverse - direct in situ combustion
2.	3196945	7-27-65	10-03-62	-	Method of forward in situ combustion with water injection
3.	3239405	3-08-66	11-04-63	-	Underground combustion process
4.	3332480	7-25-67	3-04-65	776487	Recovery of hydrocarbons by thermal methods
5.	3372750	3-12-68	11-19-65	827466	Recovery of heavy oils by steam injection
6.	3375870	4-02-68	11-19-65	827467	Recovery of petroleum by thermal methods
7.	3384172	5-21-68	11-19-65	-	Producing petroleum by forward combustion and cyclic steam injection
8.	3399722	9-03-68	5-24-67	847137	Recovery of petroleum by a cyclic thermal method
9.	3434544	3-25-69	12-22-66	-	Method for conducting cyclic steam injection recovery of hydrocarbons
10.	3459265	8-05-69	7-28-67	849320	Method for recovering viscous oil by steam drive
11.	3460621	8-12-69	5-22-67	848245	Cyclic steam injection and gas drive
12.	3464491	9-02-69	12-18-67	848244	Oil recovery from formations containing channels
13.	3481399	12-02-69	6-10-68	866576	Recovery of oil by flashing of heated connate water
14.	3504745	4-07-70	5-08-68	853995	Use of foams to prevent vertical flow in tar sands during in situ combustion

15.	3547195	12-15-70	6-19-69	881914	Pyrolitic plugging of oil bearing formations by under ground combustion
16.	3430700	3-04-69	10-16-66	852555	Recovery of petroleum by thermal methods involving transfer of heat from one section of an oil bearing formation to another
17.	3729337	4-24-73	4-20-70	-	Production of petroleum from unconsolidated formations
18.	3964547	6-22-76	10-29-74	972679	Use of tar as a diverter in steaming operations
19.	4147213	4-03-79	-	-	Combustion air injection well

b) Canadian Patents

	Canadian Patent No.	Date Issued	Date Filed	Related U.S. Patent No.	Patent Titles
1.	710136	5-25-65	2-09-61	-	Oil well reverse combustion process
2.	710137	5-25-65	2-09-61	-	Method for conducting under ground reverse combustion
3.	721099	11-09-65	10-02-59	-	Oil recovery by combustion
4.	739768	8-02-66	4-10-61	-	Underground combustion method
5.	739769	3-02-65	4-30-62	3171479	In situ combustion
6.	746725	11-22-66	12-08-58	-	Recovery of petroleum by underground combustion
7.	787182	6-11-68	10-18-63	3244229	Production of fluids from unconsolidated formations
8.	794324	10-10-68	5-04-65	-	Separation process
9.	794670	10-17-68	10-27-65	-	Method of producing hydrocarbons
10.	803818	1-14-69	5-13-66	3244229	Production of fluids from unconsolidated formations
11.	806945	2-25-69	12-06-65	-	Well pump
12.	815802	6-24-69	11-22-66	-	Valve for obtaining a sample of the fluid flowing in a pipeline
13.	820083	8-12-69	2-20-67	3366177	Production of petroleum from unconsolidated formations
14.	839042	4-14-70	3-18-66	-	Method of producing hydrocarbons from a subsurface formation by thermal treatment
15.	840211	3-28-70	1-17-66	-	Method of recovering hydrocarbons from an underground hydrocarbon containing formation

16.	840789	5-05-70	1-17-66	-	Method of producing hydrocarbons from an underground formation
17.	856023	11-17-70	2-23-68	-	Consolidating earth formations
18.	858309	12-15-70	2-23-68	-	Thermal secondary recovery
19.	890741	1-18-72	2-21-69	-	Method of recovering hydrocarbons from an underground hydrocarbon containing formation
20.	941735	2-12-74	6-01-71	-	Oil recovery using steam chemical drive fluids

TABLES

TABLE 1

Summary of Funds Committed and Disbursed to March 31, 1983

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/82 to March 31/83	Balance
Institutional Research				
Alberta Research Council				
- Information Centre	$ 3,100,000	$ 1,707,222	$ 438,174	$ 954,604
- Oil Sands Research Centre	17,893,027	11,231,921	2,877,172	3,783,934
- Sample Bank	1,002,868	606,163	261,881	134,824
- Geological Program	1,915,009	891,535	521,195	502,279
University Contracts	13,292,971	7,616,652	3,478,549	2,197,770
Professorships	2,062,056	1,356,127	546,121	159,808
Scholarships and Fellowships	2,180,000	702,398	184,823	1,292,779
Ontario Research Foundation	10,700	6,099	-	4,601
British Columbia Cancer Foundation	125,000	-	43,126	81,874
University Access Program	100,000	71,041	26,771	2,188
Alberta Research Council Access Program	25,000	-	-	25,000
	$ 41,706,631	$ 24,189,158	$ 8,377,812	$ 9,139,661
Mining and Extraction				
Retorting				
- Umatac	$ 10,550,000	$ 4,446,615	$ 1,532,063	$ 4,571,322
- Lurgi	721,820	621,165	(114,724)	215,379
Tailings Treatment				
- Xana	2,369,879	1,359,498	692,663	317,718
- EcoPlastics	63,318	59,917	-	3,401
Dredging	202,658	27,658	174,844	156
Solvent Study	26,343	26,343	-	-
Oil Sands Demonstration Centre	275,000	41,322	(33,106)	266,784
Kruyer Research	340,000	240,000	100,000	-
R.T.R. Project	100,000	100,000	-	-
	$ 14,649,018	$ 6,922,518	$ 2,351,740	$ 5,374,760
In-Situ Oil Sands				
Peace River				
- Shell	$ 74,839,351	$ 56,750,646	$ 3,416,430	$ 14,672,275
Athabasca				
- Amoco	26,947,108	24,571,714	234,416	2,140,978
- Numac/Gulf	1,650,661	1,449,464	286	200,911
- Hudson's Bay	100,000	36,843	-	63,157
- CDC Oil & Gas Limited	7,050,000	-	6,190,000	860,000
Wabasca				
- General American	1,500,000	-	1,284,680	215,320
Cold Lake				
- B.P.	23,527,750	12,527,216	2,429,899	8,570,635
Gemini	264,211	223,031	37,339	3,841
Walden	96,500	96,614	-	(114)
Francis Hankin	353,319	-	25,695	327,624
Monenco	38,000	35,000	3,000	-
Waterloo Centre	262,190	111,333	118,314	32,543
Electrical Heating Study	50,000	6,294	31,149	12,557
Water Treatment Study	75,000	3,137	(4,283)	76,146
Consultants	36,430	30,600	-	5,830
	$ 136,790,520	$ 95,841,892	$ 13,766,925	$ 27,181,703

TABLE 1 CONT'D.

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/82 to March 31/83	Balance
Underground Access				
Athabasca				
- Tunnelling	$ 177,390	$ 177,390	$ -	$ -
- Gulf Surmont Project	4,960,143	4,930,485	(20,803)	50,461
- U.T.F. Project	4,681,947	-	1,289,690	3,392,257
	$ 9,819,480	$ 5,107,875	$ 1,268,887	$ 3,442,718
Carbonate Trend				
Buffalo Creek				
- Union Oil	$ 21,985,000	$ 12,217,593	$ 6,385,525	$ 3,381,882
Heavy Oil				
Petro-Canada	$ 13,958,046	$ 8,804,478	$ 2,105,364	$ 3,048,204
A.E.C.	6,051,500	4,423,329	311,857	1,316,314
Pengalta	238,200	120,462	36,808	80,930
	$ 20,247,746	$ 13,348,269	$ 2,454,029	$ 4,445,448
Enhanced Recovery Conventional Oil				
P.R.I.	$ 500,000	$ 340,472	$ (66,805)	$ 226,333
McCallum, Stewart & Associates	27,000	23,246	3,427	327
Husky Oil	200,000	-	121,938	78,062
Norcen	125,000	-	85,289	39,711
Cold Lake Heavy Oil	600,000	-	240,260	359,740
	$ 1,452,000	$ 363,718	$ 384,109	$ 704,173
Bitumen Upgrading				
Flexicoking - Exxon	$ 500,000	$ 353,829	$ -	$ 146,171
Hydrocracking - E.M.R.	214,520	214,520	-	-
Hydrotreating - UOP	176,183	176,183	-	-
- Catalytic Inc.	206,640	198,432	2,740	5,468
Residue Utilization Project	90,000	-	10,645	79,355
Fluid Bed Combustion				
- EMR Ahlstrom Test	12,500	3,026	-	9,474
- British Columbia Research Council	84,570	-	80,108	4,462
Petrochemicals - Mitsubishi	679,500	675,853	3,787	(140)
Heavy Oil Upgrading Study	1,810,000	559,439	1,094,500	156,061
Eureka Process	415,125	16,318	417,437	(18,630)
California Synfuels	14,760	12,757	-	2,003
REM Feasibility Study	125,000	86,414	38,586	-
McKinsey & Associates Study	75,000	33,000	42,000	-
Porta Plants Inc.	10,000	-	3,632	6,368
	$ 4,413,798	$ 2,329,771	$ 1,693,435	$ 390,592
Technology Handling				
Data Base Administration	$ 2,726,595	$ 769,726	$ 549,409	$ 1,407,460
Technical Reports	91,865	91,865	-	-
AOSTRA Journal	160,000	-	5,334	154,666
Patent Costs	500,000	197,084	45,886	257,030
	$ 3,478,460	$ 1,058,675	$ 600,629	$ 1,819,156
Training Activities	$ 805,000	$ 407,548	$ 289,725	$ 107,727
International Activities	$ 1,780,800	$ 421,413	$ 232,466	$ 1,126,921
Totals	$ 257,128,453	$ 162,208,430	$ 37,805,282	$ 57,114,741

TABLE 2

Statement of Revenue Expenditure & Fund Balance

Oil Sands Technology and Research Fund
Six-Year Summary
For the years ended March 31

	1983	1982	1981	1980	1979	1978 and prior	Total
Revenue							
Alberta Heritage Savings Trust Fund	$ 39,500,000	$ 28,500,000	$ 28,000,000	$ 38,000,000	$ 33,161,289	$ 29,787,743	$ 196,949,032
Technology sales	2,876,477	3,477,561	2,362,893	282,312	407,623	15,027	9,421,893
	$ 42,376,477	$ 31,977,561	$ 30,362,893	$ 38,282,312	$ 33,568,912	$ 29,802,770	$ 206,370,925
Expenditures							
Institutional Research							
Alberta Research Council							
- Information Centre	$ 438,174	$ 394,205	$ 313,017	$ 200,000	$ 200,000	$ 600,000	$ 2,145,396
- Oil Sands ResearchCentre	2,877,172	2,369,308	2,508,783	1,336,003	1,294,191	3,723,636	14,109,093
- Sample Bank	261,881	240,975	218,361	65,763	22,064	59,000	868,044
- Geological Program	521,195	469,740	353,953	67,842	-	-	1,412,730
University Contracts	3,478,549	2,103,367	1,975,243	1,291,193	880,585	1,366,264	11,095,201
Professorships	546,121	472,084	353,813	167,730	160,000	202,500	1,902,248
Scholarships and Fellowships	184,823	201,760	85,131	121,541	107,530	186,436	887,221
Ontario Research Foundation	-	1,622	4,477	-	-	-	6,099
British Columbia Cancer Foundation	43,126	-	-	-	-	-	43,126
University Access Program	26,771	44,159	26,882	-	-	-	97,812
	$ 8,377,812	$ 6,297,220	$ 5,839,660	$ 3,250,072	$ 2,664,370	$ 6,137,836	$ 32,566,970
Mining and Extraction							
Retorting							
- Umatac	$ 1,532,063	$ 1,348,402	$ 812,790	$ 653,734	$ 528,210	$ 1,103,479	$ 5,978,678
- Lurgi	(114,724)	-	239,075	319,870	-	62,220	506,441
Tailings Treatment							
- Xana	692,663	617,160	333,242	223,455	170 594	15,047	2,052,161
- EcoPlastics	-	-	16,829	16,598	26,490	-	59,917
Dredging	174,844	-	-	16,760	10,898	-	202,502
Solvent Study	-	-	-	26,343	-	-	26,343
Oil Sands Demonstration Centre	(33,106)	18,253	23,069	-	-	-	8,216
Kruyer Research	100,000	240,000	-	-	-	-	340,000
R.T.R. Project	-	100,000	-	-	-	-	100,000
	$ 2,351,740	$ 2,323,815	$ 1,425,005	$ 1,256,760	$ 736,192	$ 1,180,746	$ 9,274,258
In-Situ Oil Sands							
Peace River							
- Shell	$ 3,416,430	$ 7,413,067	$ 6,510,798	$ 22,074,583	$ 18,204,757	$ 2,547,441	$ 60,167,076
Athabasca							
- Amoco	234,416	1,865,234	4,241,687	3,086,470	3,298,545	12,079,778	24,806,130
- Numac/Gulf	286	(36)	(20,846)	129,684	140,662	1,200,000	1,449,750
- Hudson's Bay	-	-	3,199	33,372	272	-	36,843
- CDC Oil & Gas Limited	6,190,000	-	-	-	-	-	6,190,000
Wabasca							
- General American	1,284,680	-	-	-	-	-	1,284,680
Cold Lake							
- B.P.	2,429,899	3,231,266	991,585	948,474	1,645,018	5,710,873	14,957,115
Gemini	37,339	123,544	99,487	-	-	-	260,370
Walden	-	9,346	87,268	-	-	-	96,614
Francis Hankin	25,695	-	-	-	-	-	25,695
Monenco	3,000	35,000	-	-	-	-	38,000
Waterloo Centre	118,314	111,333	-	-	-	-	229,647
Electrical Heating Study	31,149	6,294	-	-	-	-	37,443
Water Treatment Study	(4,283)	3,137	-	-	-	-	(1,146)
Consultants	-	-	-	6,630	23,970	-	30,600
	$ 13,766,925	$ 12,798,185	$ 11,913,178	$ 26,279,213	$ 23,313,224	$ 21,538,092	$ 109,608,817

TABLE 2 CONT'D.

	1983	1982	1981	1980	1979	1978 and prior	Total
Underground Access							
Athabasca							
- Tunnelling	$ -	$ -	$ -	$ 17,970	$ 39,823	$ 119,597	$ 177,390
- Gulf Surmont Project	(20,803)	1,461,788	3,101,732	366,965	-	-	4,909,682
- U.T.F. Project	1,289,690	-	-	-	-	-	1,289,690
	$ 1,268,887	$ 1,461,788	$ 3,101,732	$ 384,935	$ 39,823	$ 119,597	$ 6,376,762
Carbonate Trend							
Buffalo Creek							
- Union Oil	$ 6,385,525	$ 4,812,576	$ 2,111,852	$ 1,993,570	$ 3,299,595	$ -	$ 18,603,118
Heavy Oil							
Petro-Canada	$ 2,105,364	$ 1,577,690	$ 1,135,972	$ 4,834,786	$ 1,256,030	$ -	$ 10,909,842
A.E.C.	311,857	1,617,001	2,747,632	58,696	-	-	4,735,186
Pengalta	36,808	102,475	417	17,570	-	-	157,270
	$ 2,454,029	$ 3,297,166	$ 3,884,021	$ 4,911,052	$ 1,256,030	$ -	$ 15,802,298
Enhanced Recovery Conventional Oil							
P.R.I.	$ (66,805)	$ 304,915	$ 20,669	$ 14,888	$ -	$ -	$ 273,667
McCallum, Stewart & Associates	3,427	23,246	-	-	-	-	26,673
Husky Oil	121,938	-	-	-	-	-	121,938
Norcen	85,289	-	-	-	-	-	85,289
Cold Lake Heavy Oil	240,260	-	-	-	-	-	240,260
	$ 384,109	$ 328,161	$ 20,669	$ 14,888	$ -	$ -	$ 747,827
Bitumen Upgrading							
Flexicoking - Exxon	$ -	$ -	$ -	$ -	$ -	$ 353,829	$ 353,829
Hydrocracking - E.M.R.	-	-	-	-	-	214,520	214,520
Hydrotreating - UOP	-	-	-	88,785	87,398	-	176,183
- Catalytic	2,740	53,747	144,685	-	-	-	201,172
Residue Utilization Project	10,645	-	-	-	-	-	10,645
Fluid Bed Combustion - EMR/Ahlstrom Test	-	3,026	-	-	-	-	3,026
- British Columbia Research Council	80,108	-	-	-	-	-	80,108
Petrochemicals - Mitsubishi	3,787	2,853	2,877	265,855	359,194	45,074	679,640
Heavy Oil Upgrading Study	1,094,500	494,281	65,158	-	-	-	1,653,939
Eureka Process	417,437	16,318	-	-	-	-	433,755
California Synfuels	-	12,757	-	-	-	-	12,757
REM Feasibility Study	38,586	86,414	-	-	-	-	125,000
McKinsey & Associates Study	42,000	33,000	-	-	-	-	75,000
Porta Plants Inc.	3,632	-	-	-	-	-	3,632
	$ 1,693,435	$ 702,396	$ 212,720	$ 354,640	$ 446,592	$ 613,423	$ 4,023,206
Technology Handling							
Data Base Administration	$ 549,409	$ 333,810	$ 116,073	$ 198,691	$ 121,152	$ -	$ 1,319,135
Technical Reports	-	-	91,865	-	-	-	91,865
AOSTRA Journal	5,334	-	-	-	-	-	5,334
Patent Costs	45,886	52,277	66,184	78,623	-	-	242,970
	$ 600,629	$ 386,087	$ 274,122	$ 277,314	$ 121,152	$ -	$ 1,659,304
Training Activities	$ 289,725	$ 207,109	$ 200,439	$ -	$ -	$ -	$ 697,273
International Activities	$ 232,466	$ 244,408	$ 177,005	$ -	$ -	$ -	$ 653,879
	$ 37,805,282	$ 32,858,911	$ 29,160,403	$ 38,722,444	$ 31,876,978	$ 29,589,694	$ 200,013,712
Excess of revenue over expenditures	$ 4,571,195	$ (881,350)	$ 1,202,490	$ (440,132)	$ 1,691,934	$ 213,076	$ 6,357,213
Fund balance at beginning of period	1,786,018	2,667,368	1,464,878	1,905,010	213,076	-	-
Fund balance at end of period	$ 6,357,213	$ 1,786,018	$ 2,667,368	$ 1,464,878	$ 1,905,010	$ 213,076	$ 6,357,213

AUDITOR'S REPORT AND FINANCIAL STATEMENTS

Alberta Oil Sands Technology and Research Authority

Oil Sands Technology and Research Fund

Financial Statements

March 31, 1983

Auditor's Report

Balance Sheet

Statement of Revenue, Expenditure and Fund Balance

Notes to the Financial Statements

ALBERTA LEGISLATURE

OFFICE OF THE AUDITOR GENERAL

AUDITOR'S REPORT

To the Members of the Alberta Oil
Sands Technology and Research Authority

I have examined the balance sheet of the Alberta Oil Sands Technology and Research Authority - Oil Sands Technology and Research Fund as at March 31, 1983 and the statement of revenue, expenditure and fund balance for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Fund as at March 31, 1983 and the results of its operations for the year then ended in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

C.A.
Auditor General

Edmonton, Alberta
June 23, 1983

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

BALANCE SHEET

AS AT MARCH 31, 1983

	1983	1982
ASSETS		
Current:		
Cash	$14,786,245	$4,344,103
Deposits in trust (Note 3)	410,625	279,801
Deposits on projects, net (Note 4)	1,985,885	936,338
Accounts receivable	1,044,563	1,495,222
Prepaid expense	2,509	5,740
	$18,229,827	$7,061,204
LIABILITES		
Current:		
Accounts payable	$11,342,146	$4,995,385
Holdbacks payable	530,468	279,801
	11,872,614	5,275,186
Fund balance, Statement B	6,357,213	1,786,018
	$18,229,827	$7,061,204

The accompanying notes are part of these financial statements.

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

STATEMENT OF REVENUE, EXPENDITURE AND FUND BALANCE

FOR THE YEAR ENDED MARCH 31, 1983

	1983	1982
Revenue:		
Contributions by the Province of Alberta:		
Alberta Heritage Savings Trust Fund (Note 6)	$39,500,000	$28,500,000
Technology sales	2,876,477	3,477,561
	42,376,477	31,977,561
Expenditure:		
In situ oil sands, net	15,035,812	14,259,973
Institutional research	8,377,812	6,297,220
Carbonate trend	6,385,525	4,812,576
Heavy Oil, net	2,454,029	3,297,166
Mining and extraction	2,351,740	2,323,815
Bitumen upgrading	1,693,435	702,396
Technology handling	600,629	386,087
Enhanced recovery	384,109	328,161
Training activities	289,725	207,109
International activities	232,466	244,408
	37,805,282	32,858,911
Excess of revenue over expenditure for the year	4,571,195	(881,350)
Fund balance at beginning of year	1,786,018	2,667,368
Fund balance at end of year	$ 6,357,213	$ 1,786,018

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

NOTES TO THE FINANCIAL STATEMENTS

MARCH 31, 1983

Note 1 Authority

The Alberta Oil Sands Technology and Research Authority operates under the authority of The Oil Sands Technology and Research Authority Act, Chapter 0-6, Revised Statutes of Alberta 1980.

Note 2 Significant Accounting Policies

The statements present Fund transactions only, therefore, those costs charged to the General Revenue Fund are not shown on the balance sheet or on the statement of revenue, expenditure and fund balance but are disclosed in Note 7.

Expenditures from the Fund are not capitalized due to the intangible nature of assets that may accrue to the Authority. The Authority will be entitled to share in any assets remaining at the end of a project in proportion to its percentage of participation.

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 Change to Prior Period Accounts Payable

Accounts payable and expenditures — institutional research for the year ended March 31, 1982 were overstated by $500,000 as a result of including a commitment to the Alberta Research Council to provide funding for an approved project in 1982-83. This overstatement has been corrected and has resulted in a decrease in 1982 accounts payable and expenditure — institutional research to $4,995,385 and $6,297,220, respectively, and an increase in the fund balance at the end of the year to $1,786,018.

Note 4 Deposits in Trust

Deposits in trust consist of deposits in the General Trust Fund of the Province of Alberta.

Note 5 Deposits on Projects

The amount of $1,985,885 (1982 $936,338) shown on the balance sheet represents the net excess of cash calls on projects over actual expenditures.

Note 6 Advances from the Province of Alberta

The Oil Sands Technology and Research Authority Act provides for advances from the General Revenue Fund of the Province of Alberta not to exceed $100,000,000.

Note 7 Contributions by the Province of Alberta

The Appropriation (Alberta Heritage Savings Trust Fund, Capital Projects Division) Act, 1981 provided for payments to the Authority to a maximum of $74,000,000 for the year ended March 31, 1983 (1982 $61,000,000). Amounts actually received from this source totalled $39,500,000 (1982 $28,500,000) The provision which enables the Authority to receive funds up to the stated maximum lapses at the end of the fiscal year.

Note 8 Administration Costs

Administration Costs of the Authority, provided for by Section 13 of the Act, are paid by the Province from funds appropriated for that purpose and are summarized as follows:

	1983	1982
Salaries and wages	$1,353,124	$1,030,349
Fees and commissions	734,583	387,865
Rental of property and equipment	480,984	253,727
Employee benefits	194,629	137,441
Travelling and hospitality	189,438	198,971
Materials and supplies	44,138	27,279
Furniture and equipment purchases	39,059	30,302
Freight, express and postage	19,956	15,691
Equipment maintenance	13,224	7,499
Telephone and telegraph	12,089	11,085
Advertising	9,182	21,368
Staff relocation costs	5,748	15,338
Grants	3,214	13,600
Contracts for construction	200	15,896
Unitar conference	-	19,607
	$3,099,568	$2,186,018

Note 9 Commitments

In addition to the total expenditure shown on Statement B, the Authority had outstanding commitments as at March 31, 1983 totalling $57,114,741 (1982 $39,291,013) for approved projects.

Note 10 Approval of Financial Statements

These financial statements were approved by management on June 23, 1983.

POOR

QUALITY

ORIGINAL